VECTORS vs SCALAR

A *scalar* quantity is one that can be described by a single number:
temperature, speed, mass

A *vector* quantity deals inherently with both magnitude and direction:
velocity, force, displacement

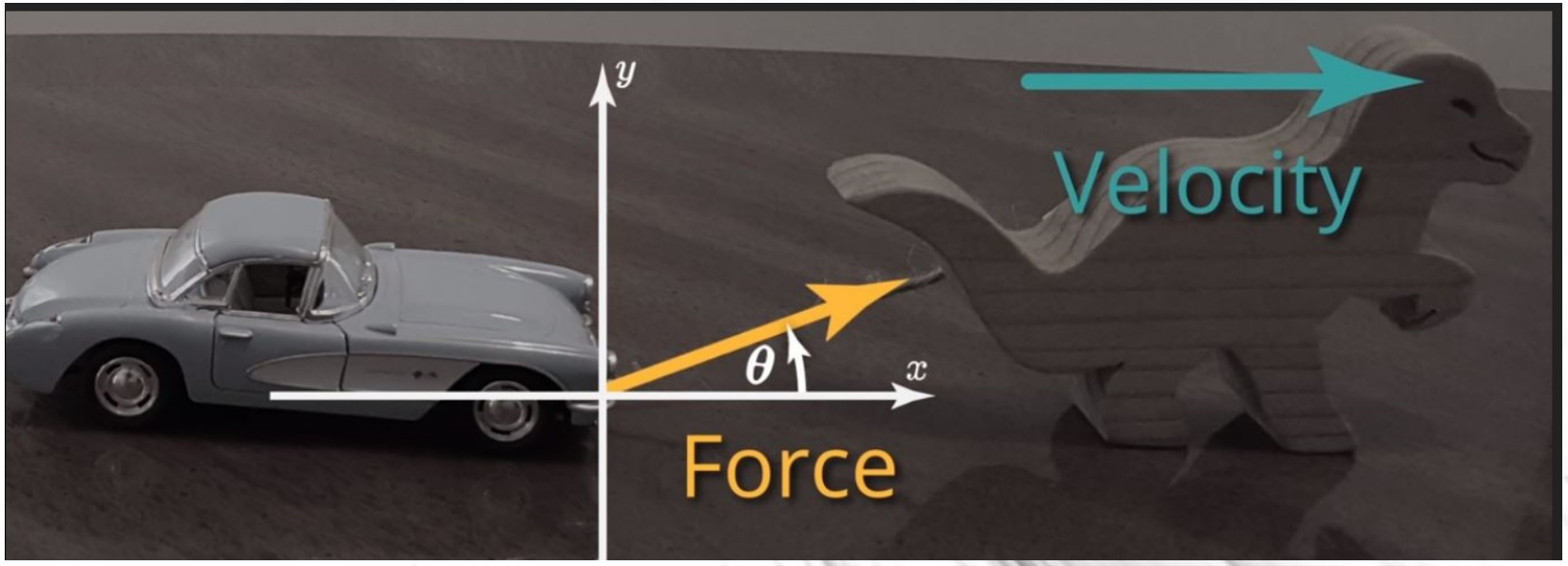
HOW MUCH ? OF WHAT ? WHICH WAY ?

WHICH quantity is not a vector

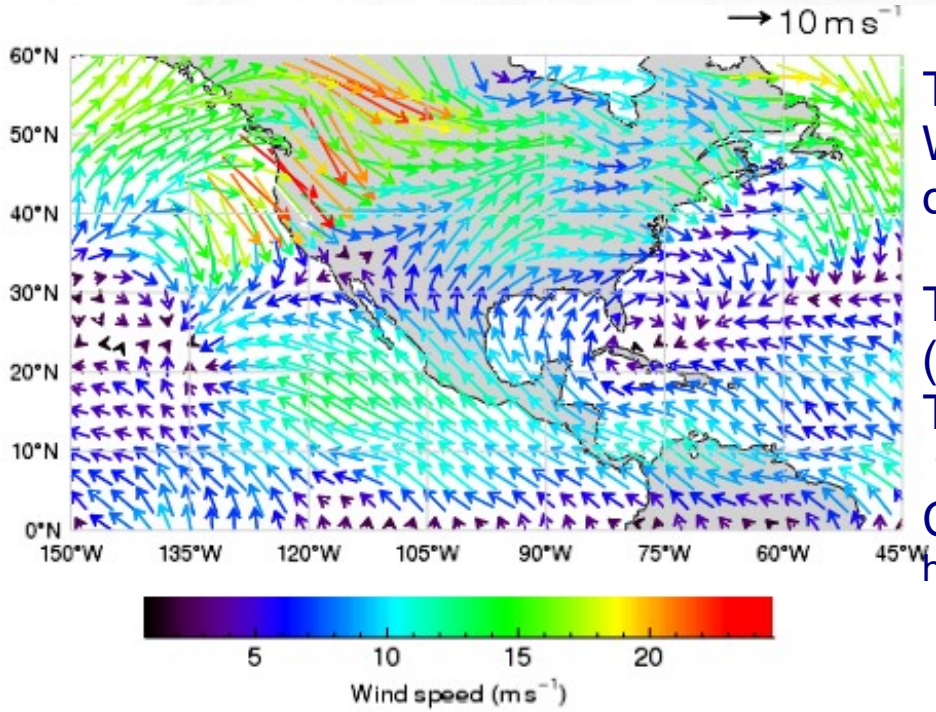
1. force
2. speed
3. acceleration
4. displacement

WHICH quantity is a scalar

1. distance
2. velocity
3. acceleration
4. displacement



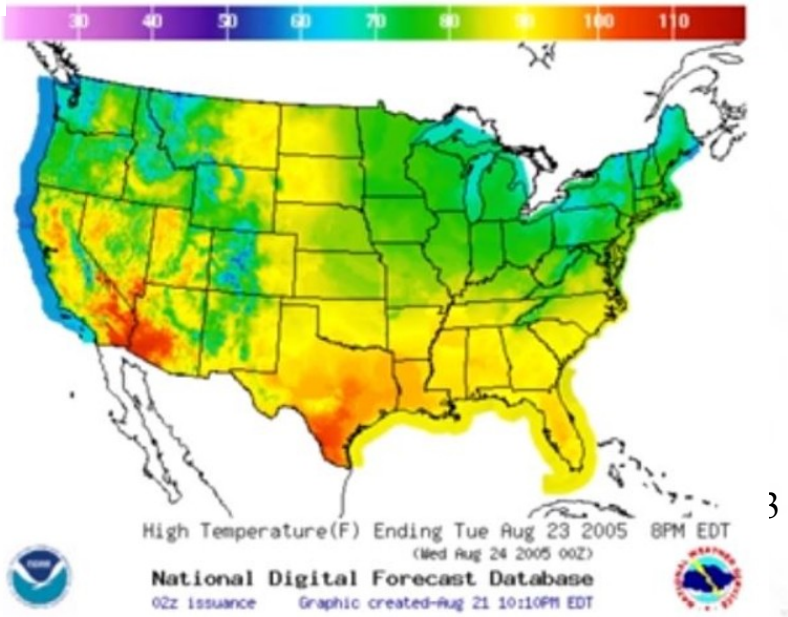
VECTOR FIELD



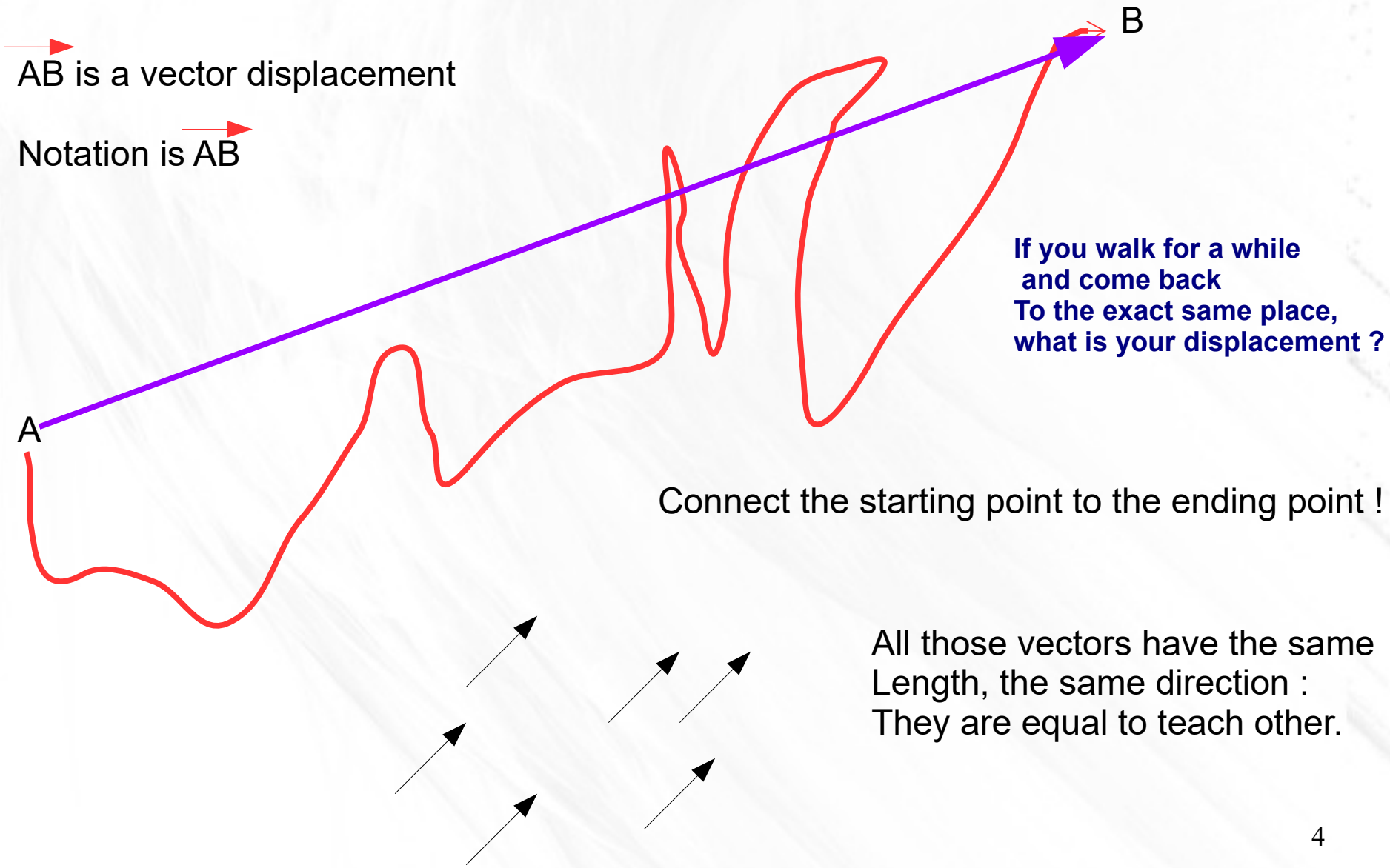
This map shows the velocities of the Wind. The velocities have a magnitude, units and direction

The velocities have a magnitude (speed of wind from 0 to 25)
The length of the arrows are proportional to the magnitude.
Colors are also used to show the magnitude.
https://www.harrisgeospatial.com/docs/vectors.html

SCALAR FIELD



Trace the vector displacement : connect the starting point A to the end point B. A is is the tail of the vector and B the head.



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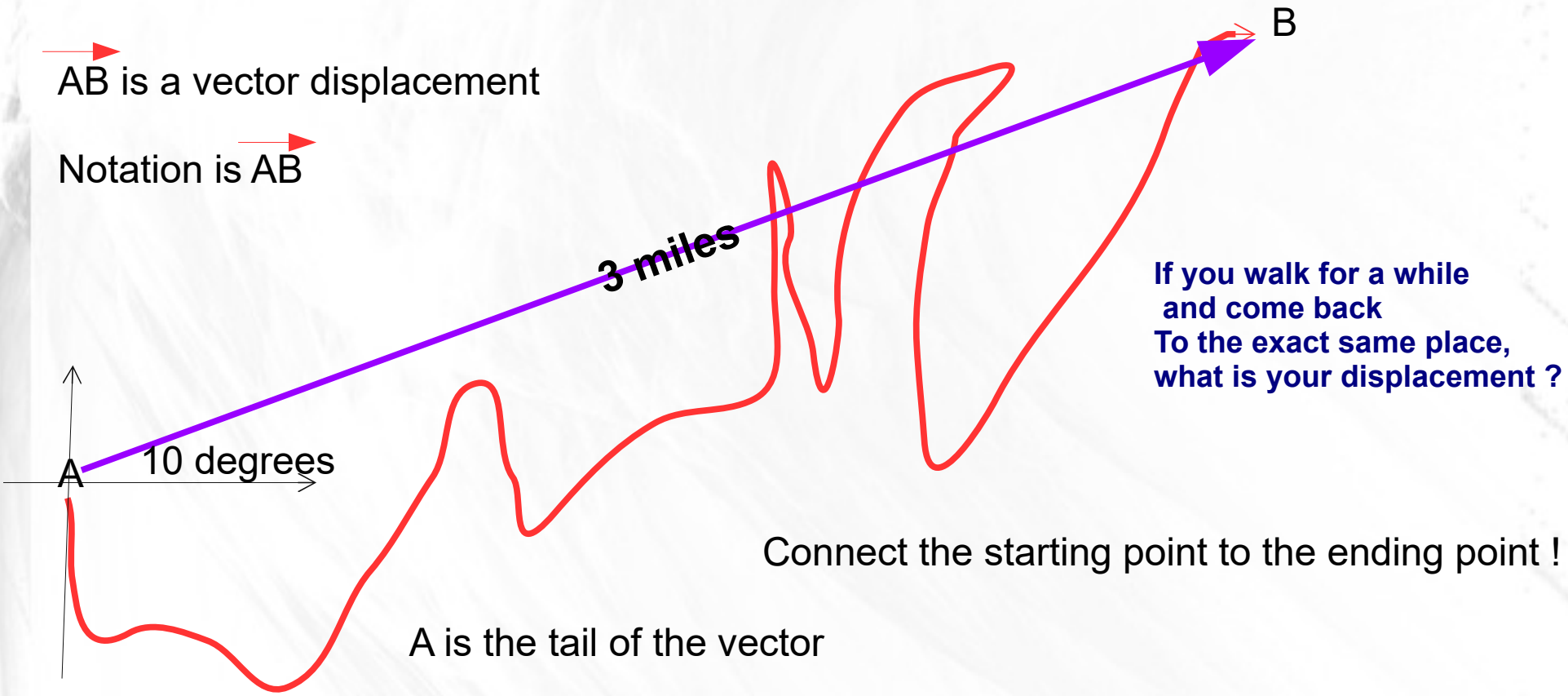


Connect the starting point to the ending point !

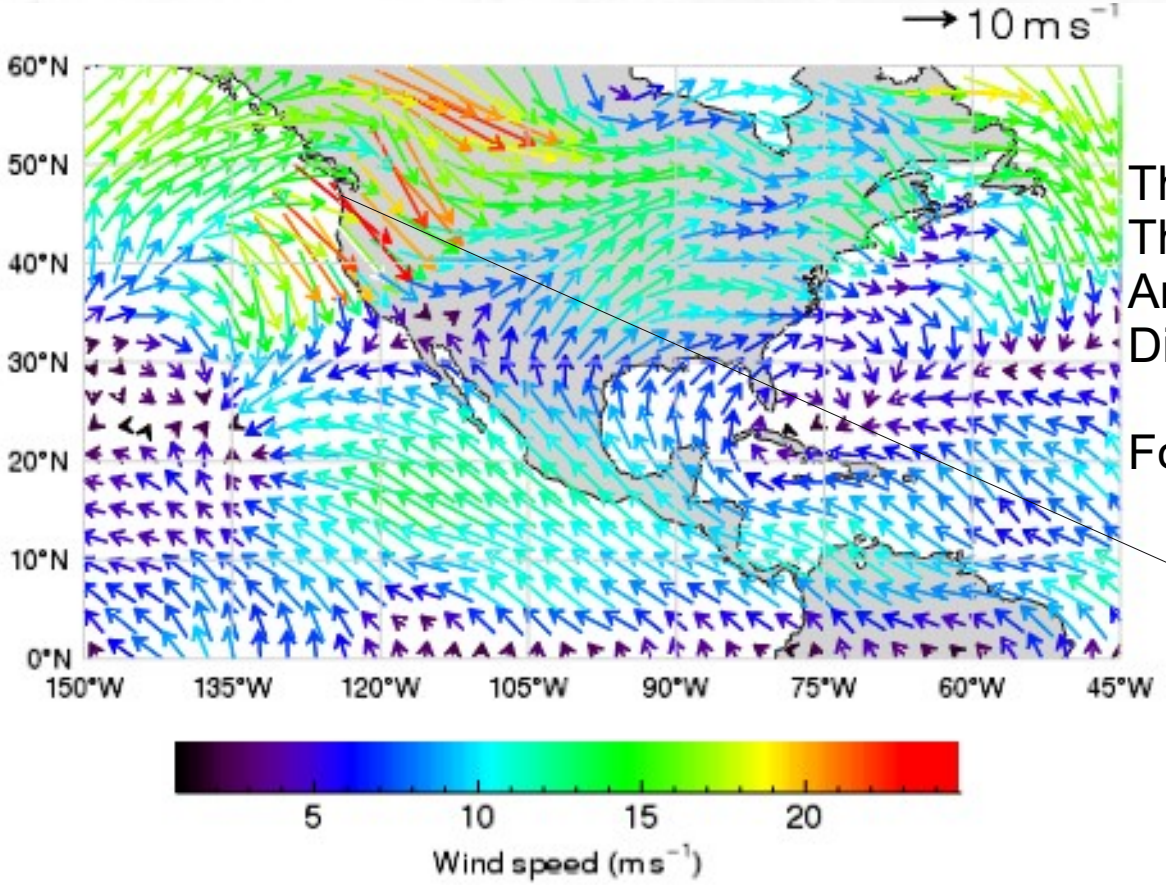
A is the tail of the vector

B is the head of the vector

The length of the segment AB (3 miles here) is the magnitude

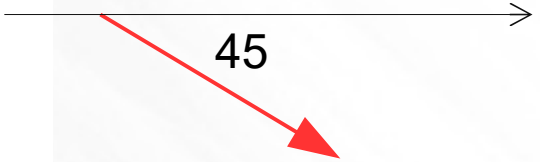
The direction is 10 degrees North of East

AB=3miles @ 10 degrees N of E (or just 10)



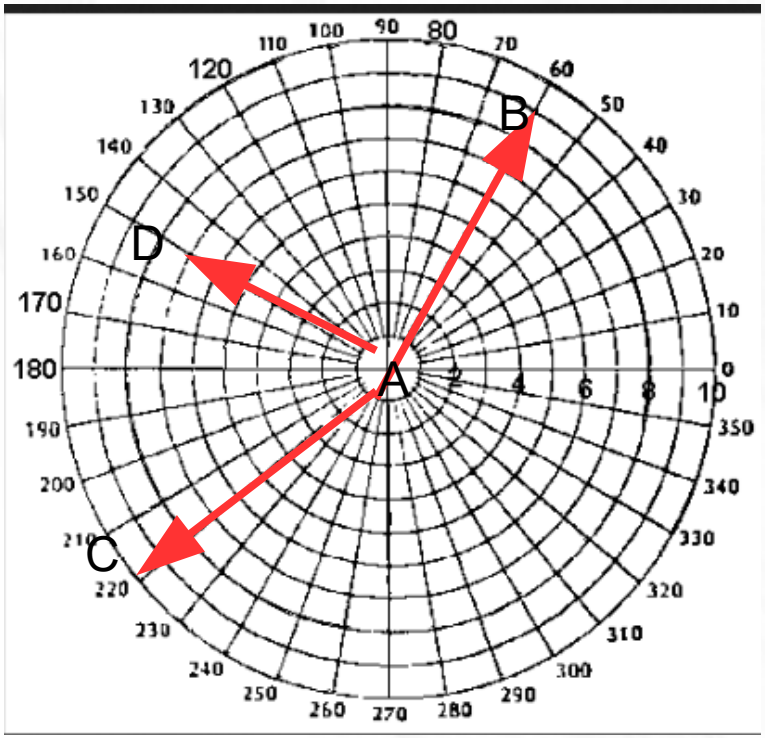
These are velocity vectors.
The magnitudes are given by the colors
And by the scale at the top right of figure.
Direction can be approximated.

For example:



30m/s @ 45 degrees south of east

Polar coordinates of vectors or standard notation



In polar coordinates, the angle increase
From the positive x-axis counterclockwise
From 0 to 360

For example vector AB = 9 units @ 60

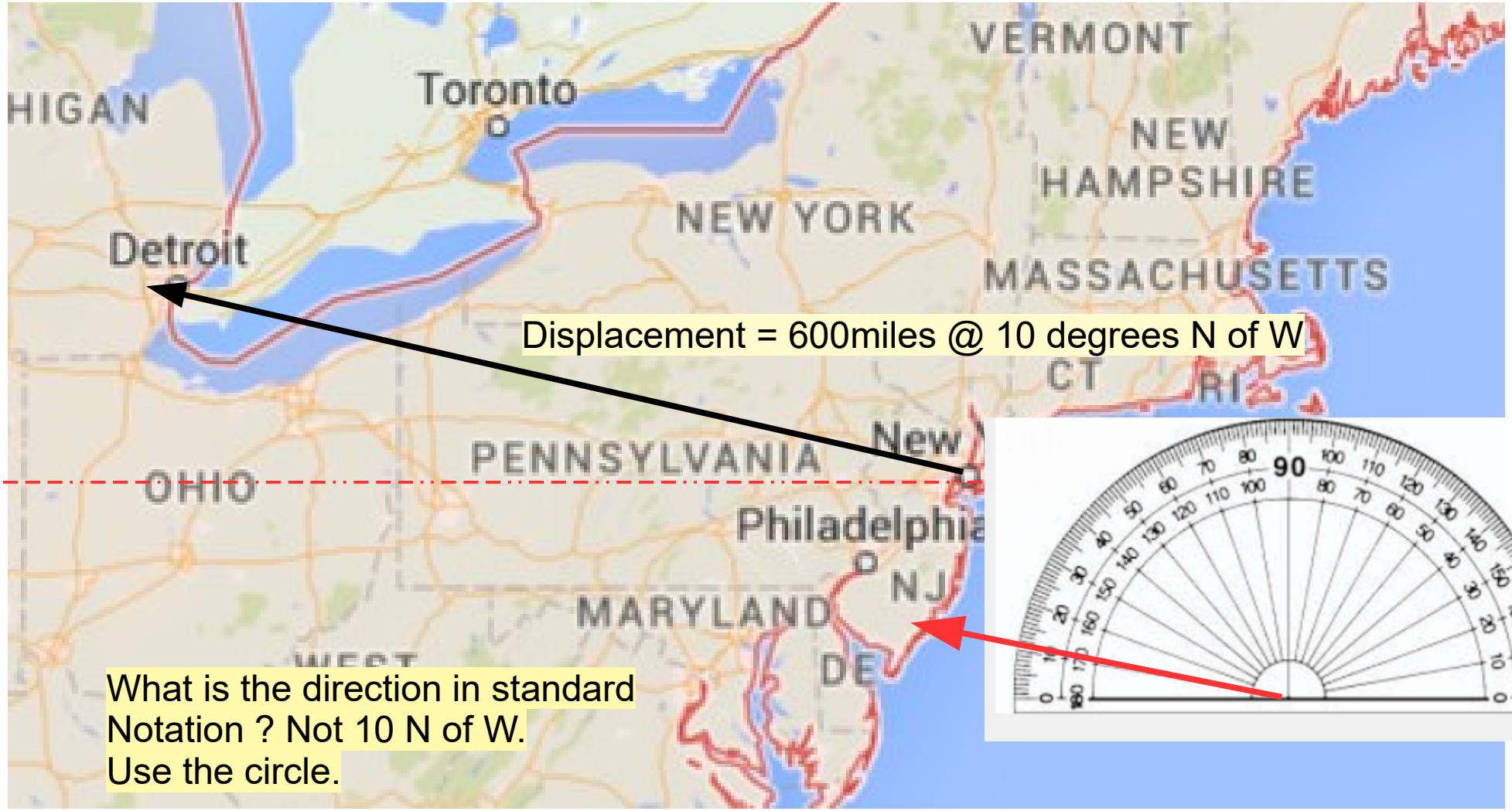
AC = 10 units @ 220

This is called the standard notation for Vectors.

AD =

The vector represents the displacement NYC – Detroit.
It is has magnitude, a unit, a direction

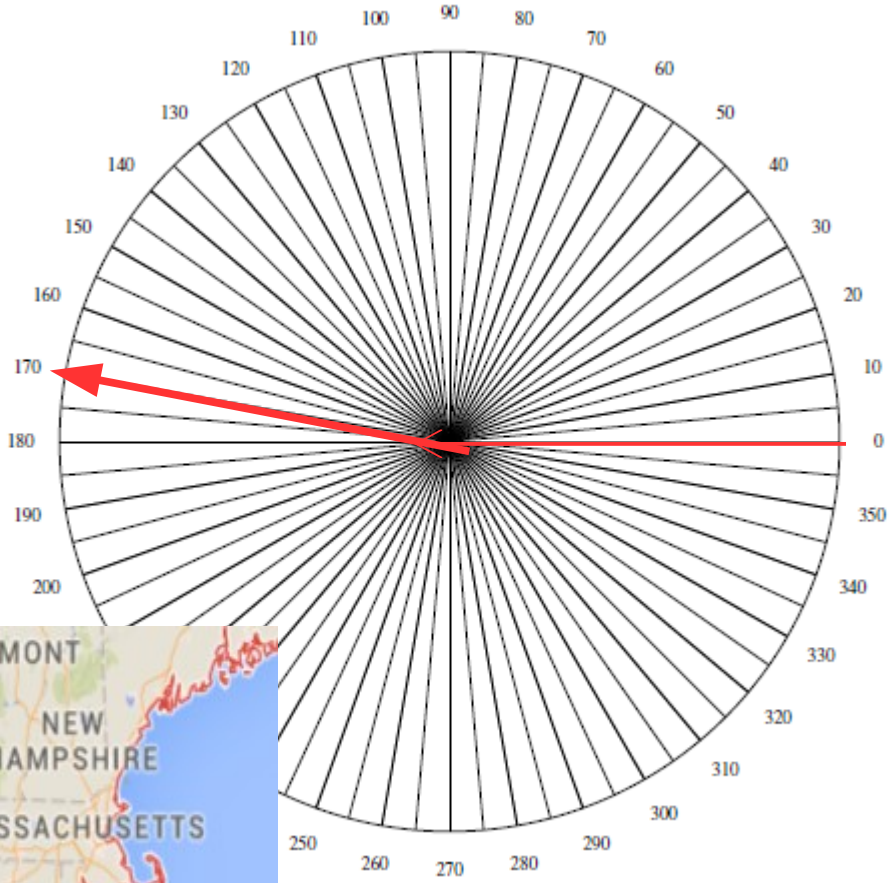
Displacement = _____ @ _____
The distance is in blue is a scalar.



In Physics / Math we prefer
The notation:

600 miles @ 170

It is the polar notation
Or standard notation
See doc polar coordinate.

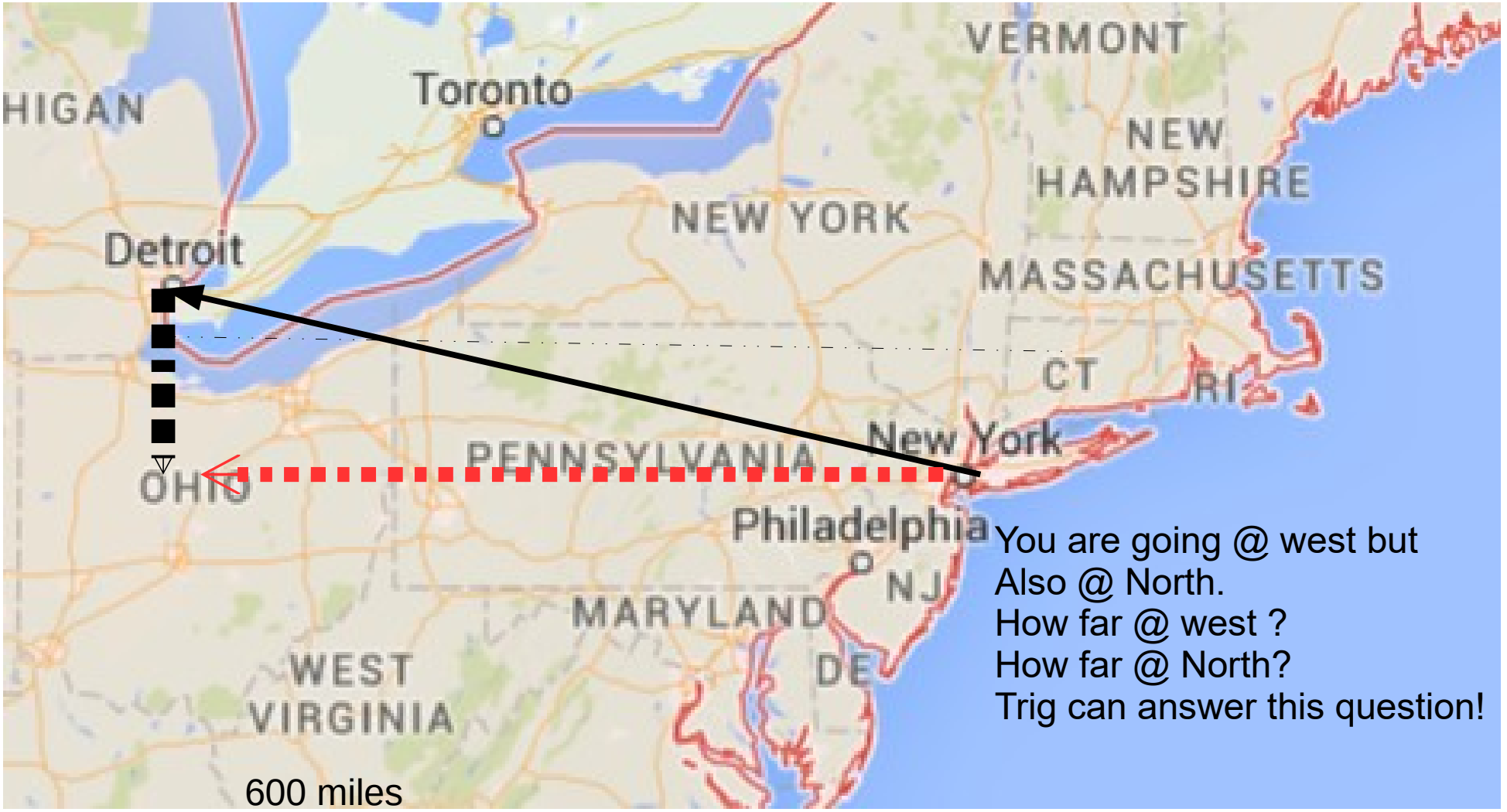


In the shared folder you
Will find the circle above.

VECTORS in PARTS: components of vectors

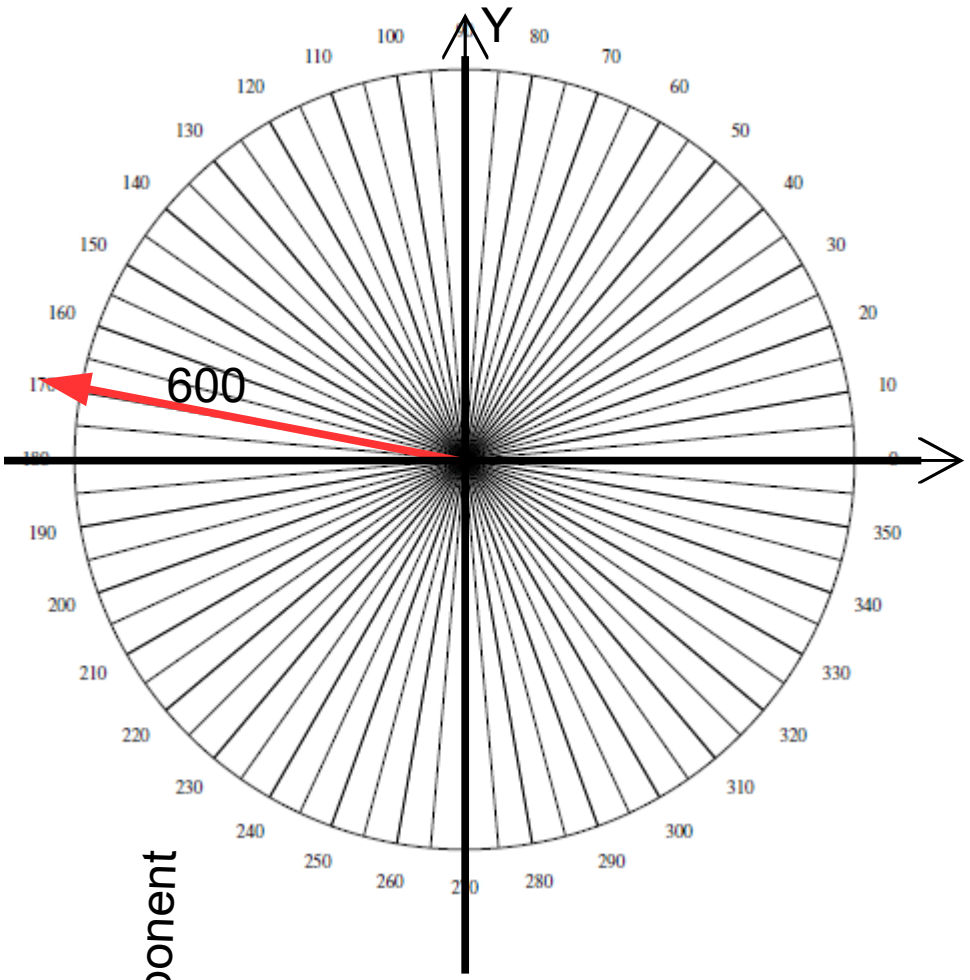
Vectors come in parts. A vector has 2 components in 2D.
A horizontal component along the x-axis or W-E direction
and a vertical component along the y-axis or the S-N direction

Here you can find how far in the West direction and how far in the North direction



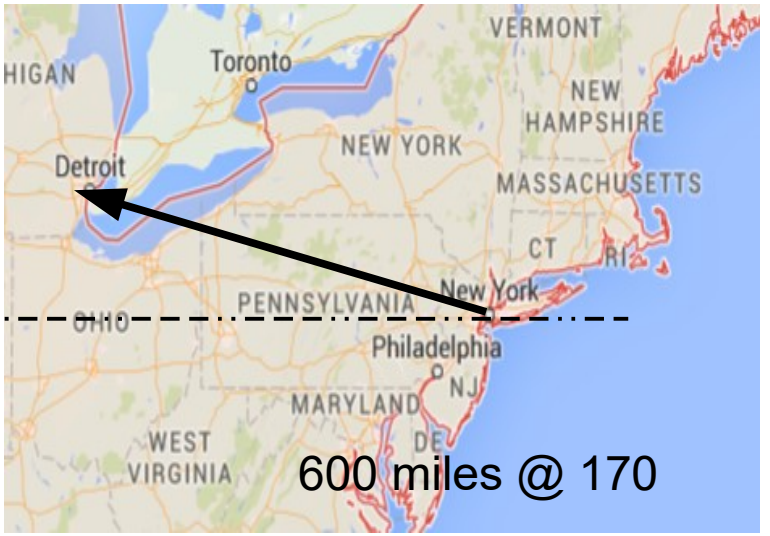
Find the components of the vector displacement.
The magnitude is 600 miles and the angle is 170 degree. Use trig.

From tail run then rise/fall to find the head.



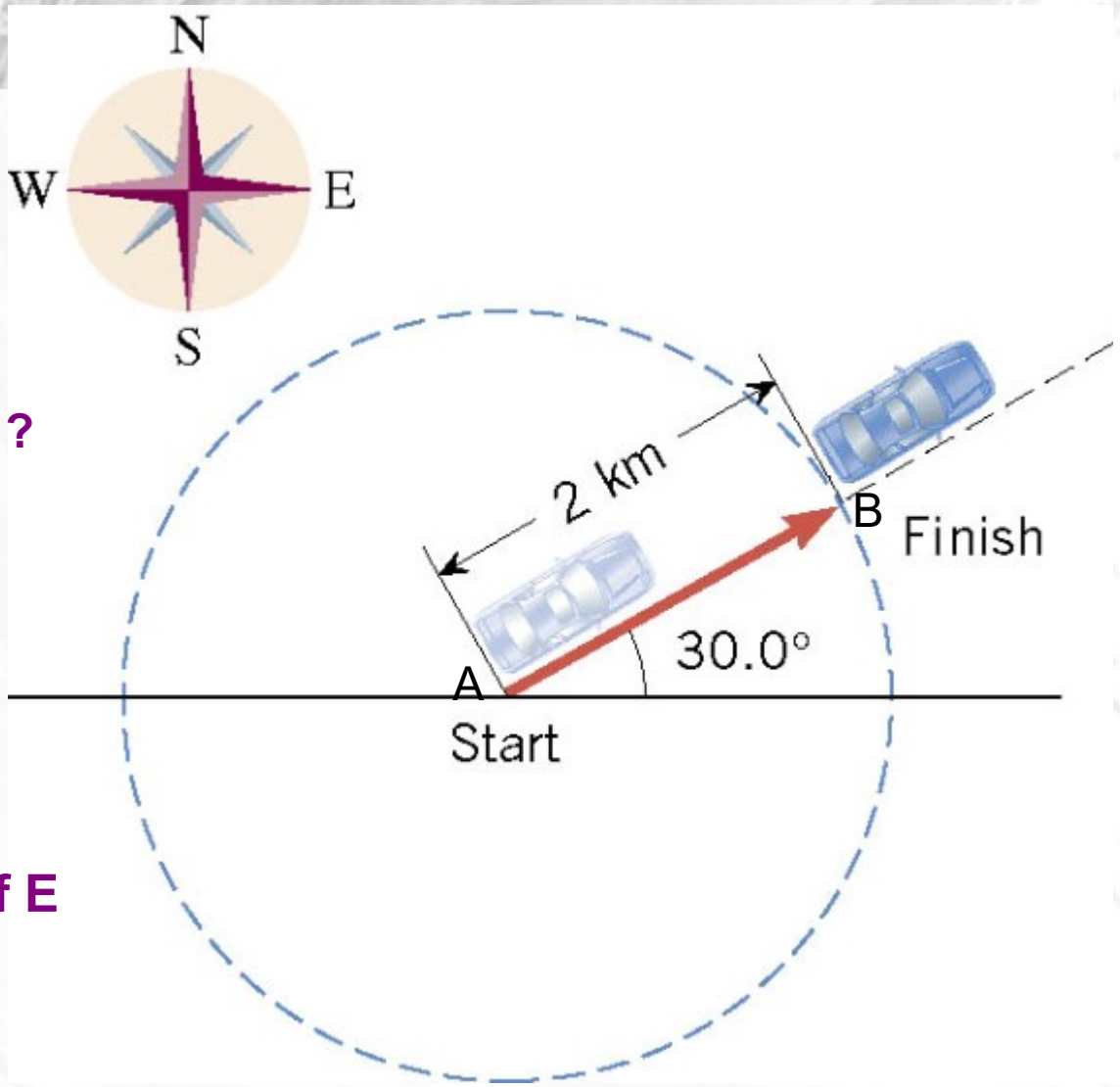
How far west ? → x-component (run)
600 cos(170) =

How far North ? → y-component (rise/fall)
600 sin(170) =



finding components of vectors

- Vector has a magnitude + direction
- Attach the tail of the vector at the origin of a x-y coordinate system. Keep the direction the same.
- Using a polar graph find the angle in the circle. (go counterclockwise)
- X-component is magnitude x cosine(angle)
- Y-component is magnitude x sine(angle)



What is the displacement of the car ?
(2 answers are correct)

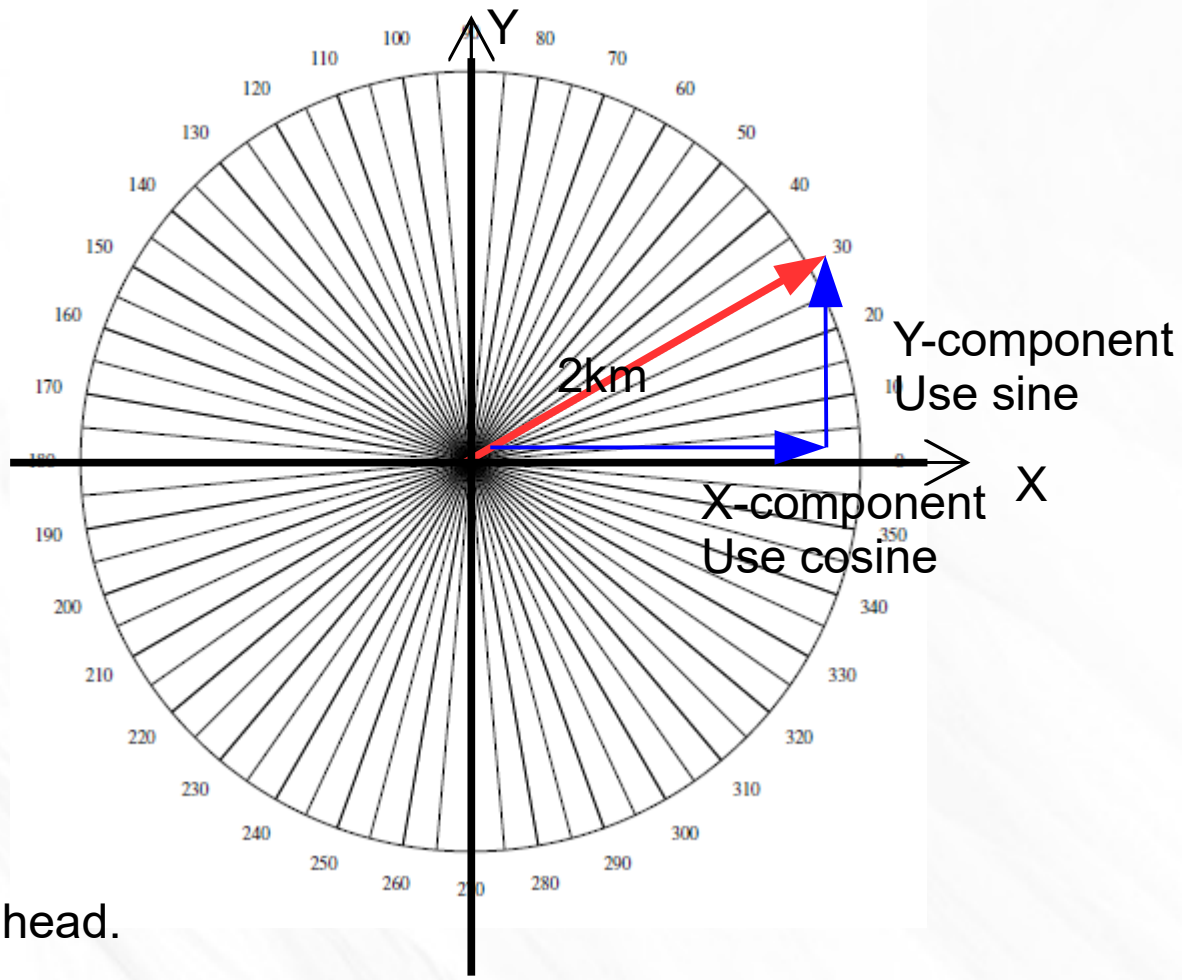
1. $\vec{AB}$ = 2km @ 30 degrees

2. $\vec{AB}$ = 2 @ 30 degrees N of E

3. $\vec{AB}$ = 2km @30 degrees N of E

4. $\vec{AB}$ = 2 km @ 170 degrees N of E

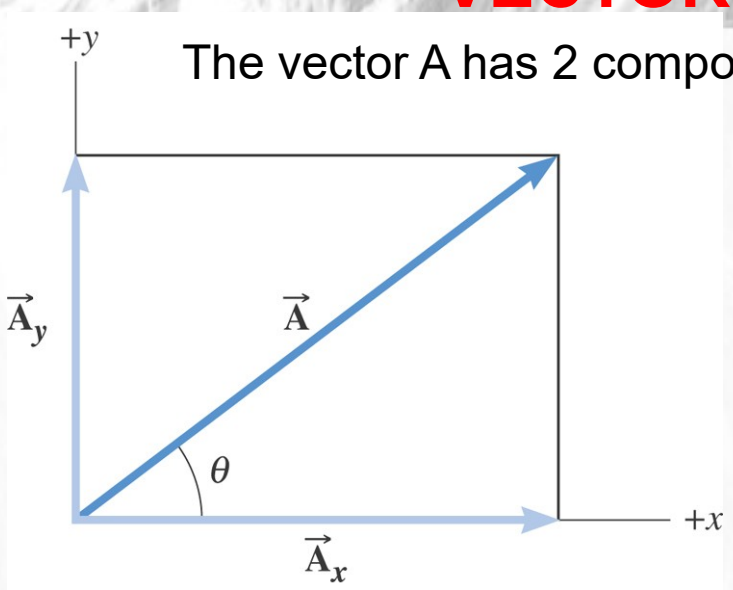
Compute the components of the vector displacement (x-component and y. component) See next slide.

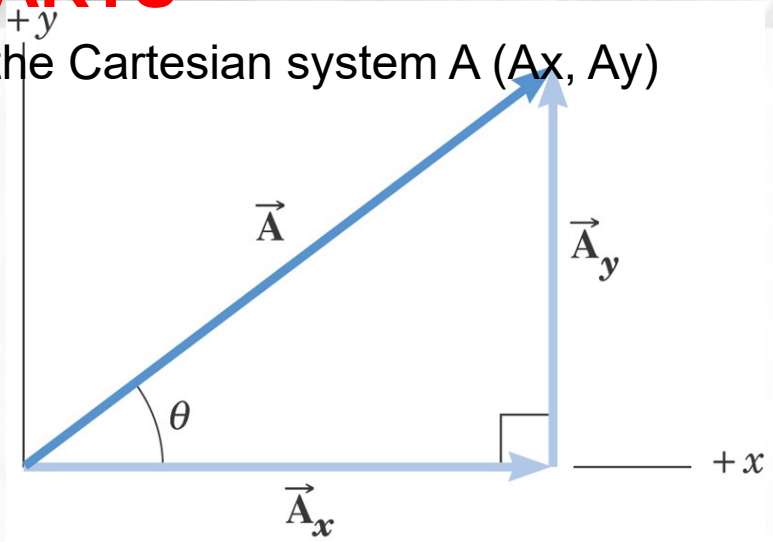


From tail run
Then rise to find head.

VECTORS in PARTS

The vector A has 2 components in the Cartesian system A (Ax, Ay)





If **A is a vector displacement** (walking/moving from start to end) Then Ax is the horizontal displacement or x-component. (how far did you move along horizontal or here @ east). Ay is the vertical component or y-component how far did you move along vertical or here @ North).

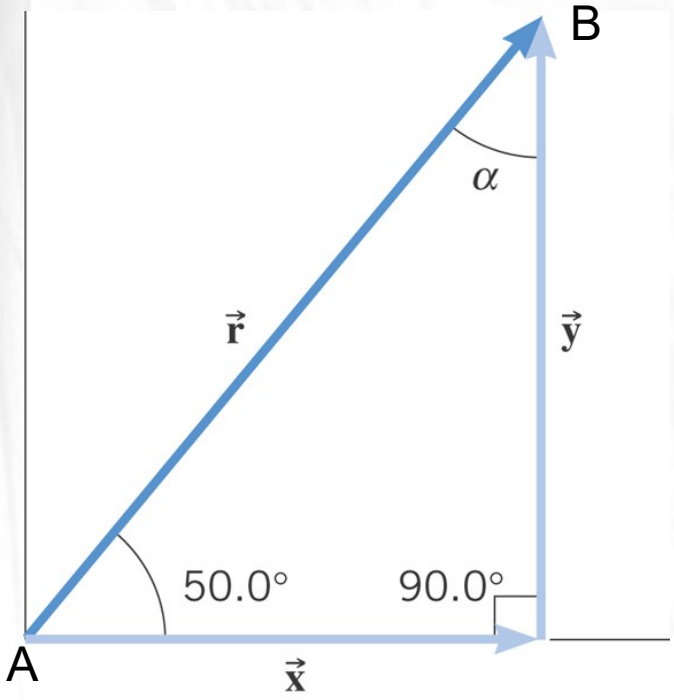
If **A is a velocity**. Ax is how fast you move along horizontal Or how fast you move @ east. Ay is how fast you move along Vertical or @ North.

If **A is a force.** Ax is pull/push along the east. Ay the pull/push along west

Example

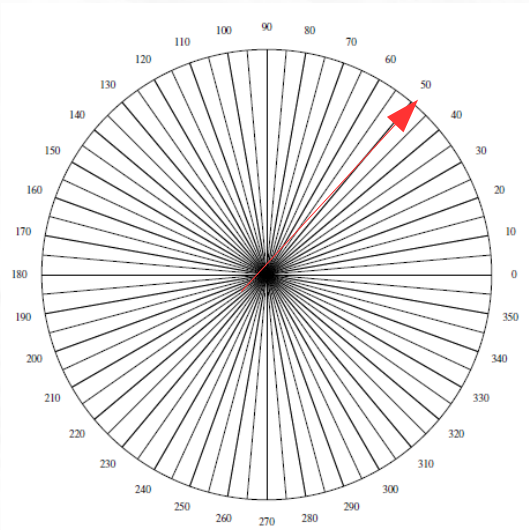
A displacement vector has a magnitude of 175 m and points at an angle of 50.0 degrees relative to the *x* axis. Find the *x* and *y* components of this vector.

- **R = 175m@50 degrees CCW about x-axis**



X and Y (round to nearest one) :

1. 209m m and 134 m
2. 134m and 113m
3. 113m and 134m



A) During the execution of a play, a football player carries the ball for a distance of 33 m in the direction 76° north of east. To determine the number of meters gained on the play, find the northward component of the ball's displacement.

Trace first the vector !!!!

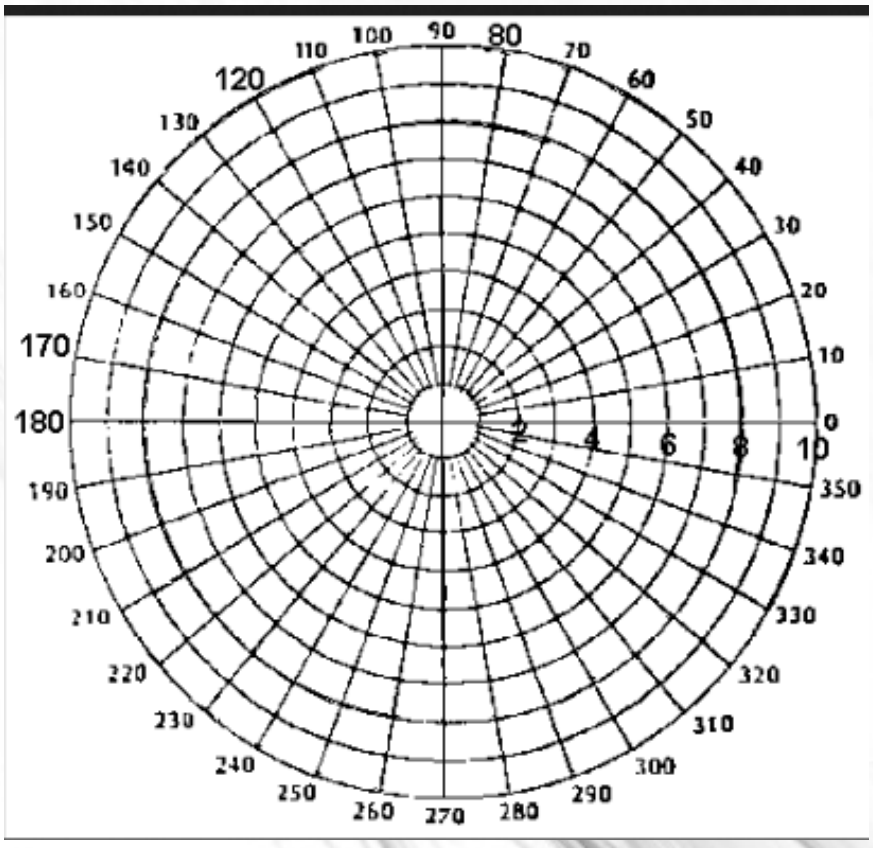
a) 8.0 m

b) 16 m

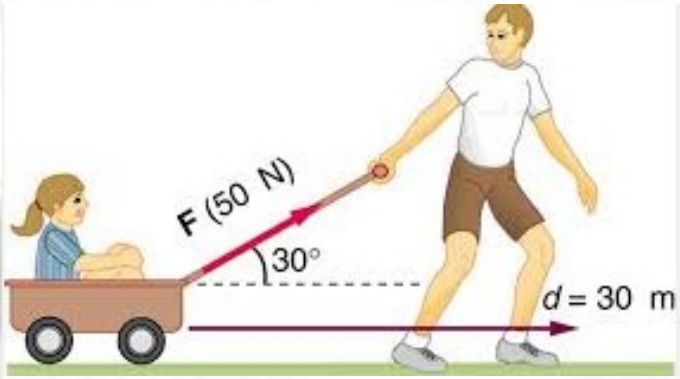
c) 24 m

d) 28 m

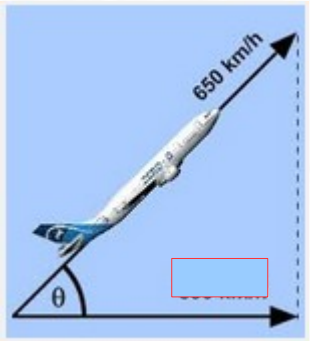
e) 32 m



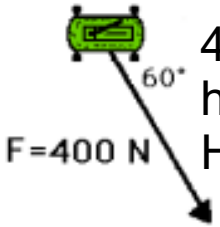
33sin(76)



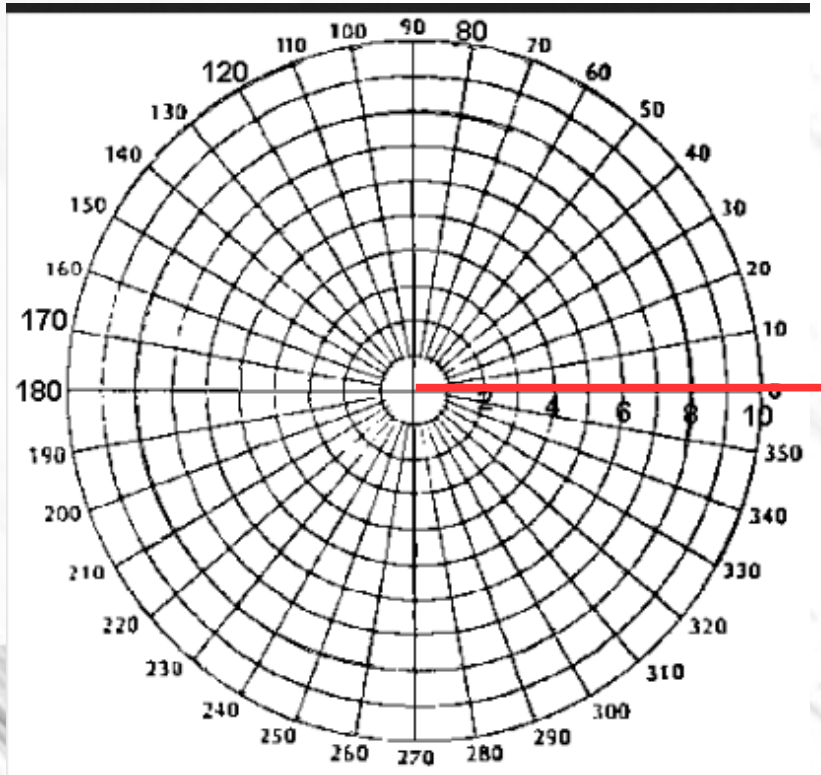
2) F = ____ @ _____
What is the pull @ east
What is the pull @ north

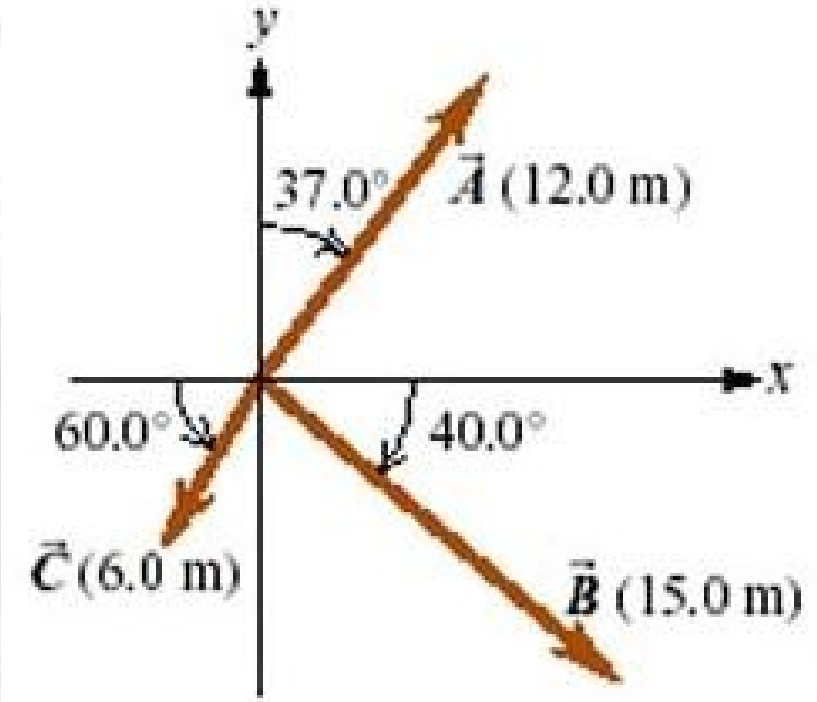


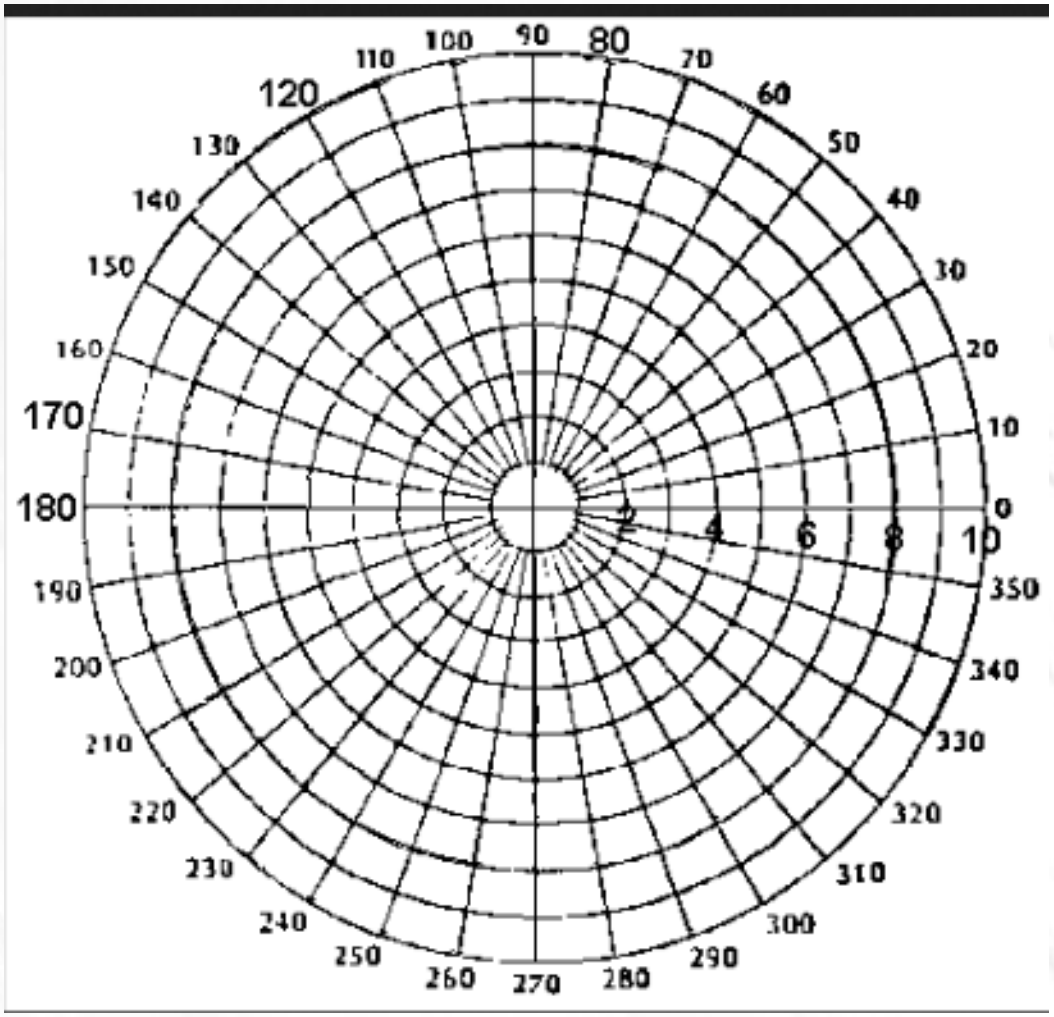
3) V = _____ @ 45
how fast it is going @ east
How fast it is going to North



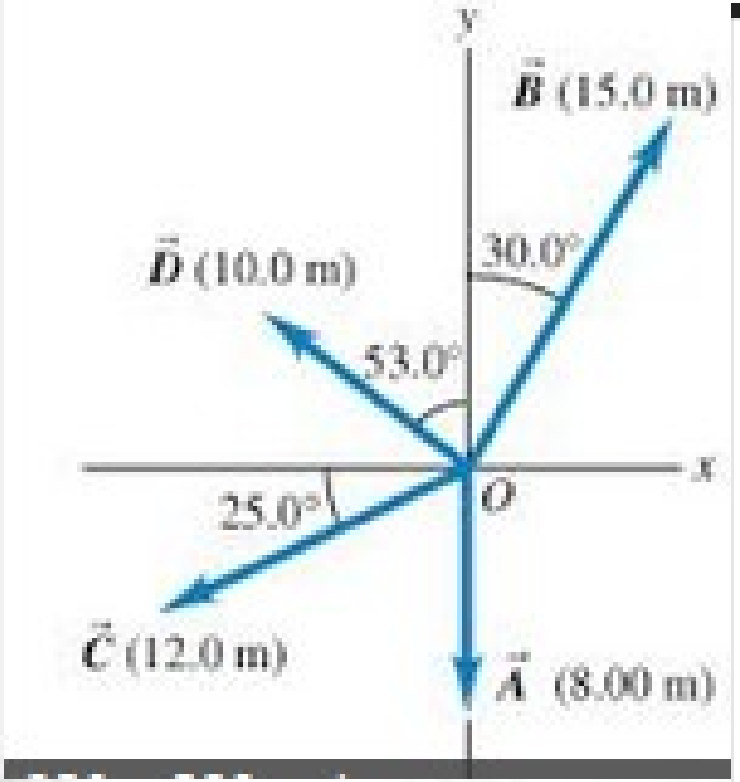
4) F= _____ @ _____
how mush the wind is pushing @ east
How much the wind is pushing @ south

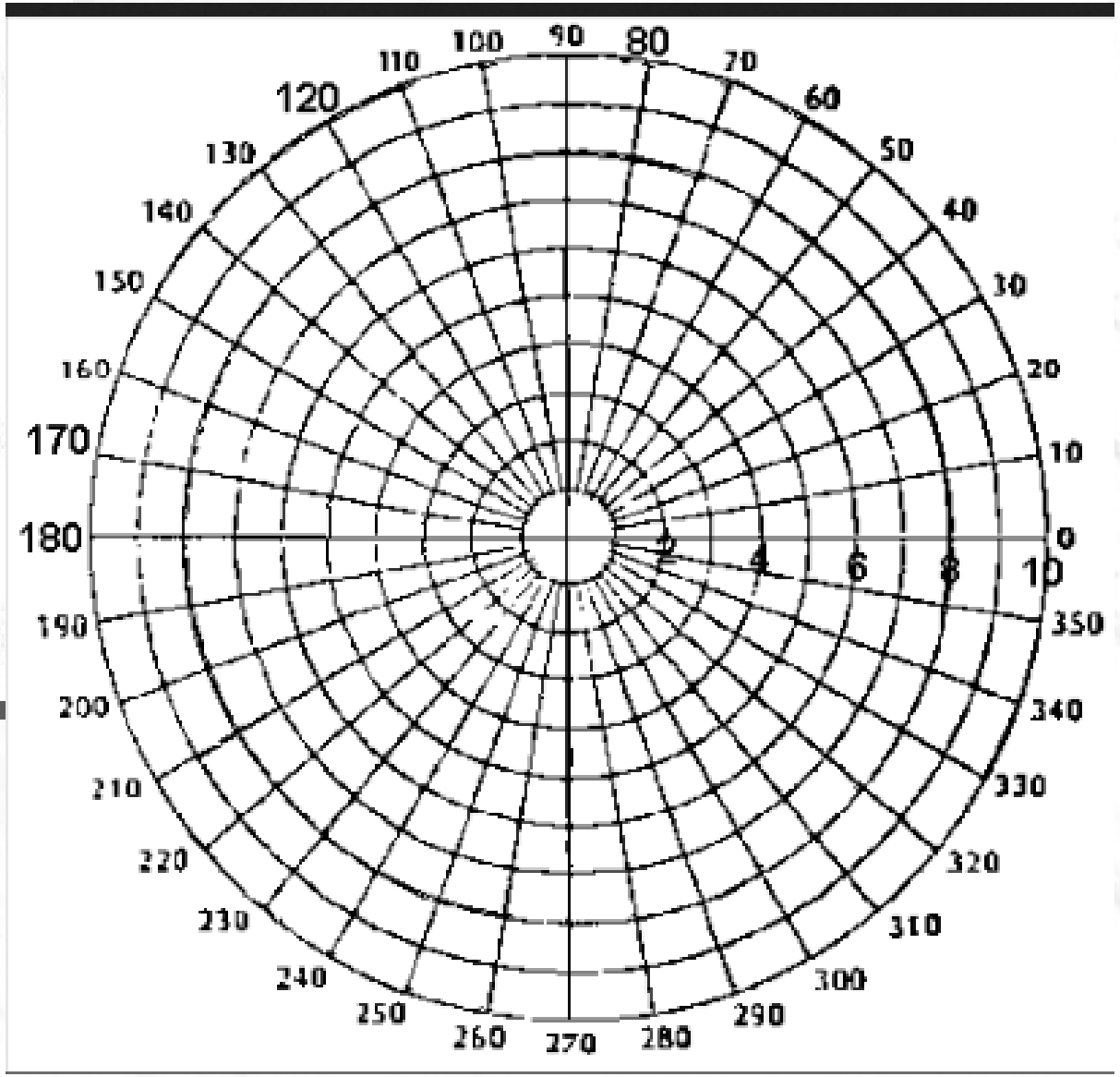






Find the components of each vector





- standard notation
- components
- coordinates

For Tuesday

Find the components of each vector

Assignment:
https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-trig-ratios-intro/v/basic-trigonometry

(0) Sum angles = 180°

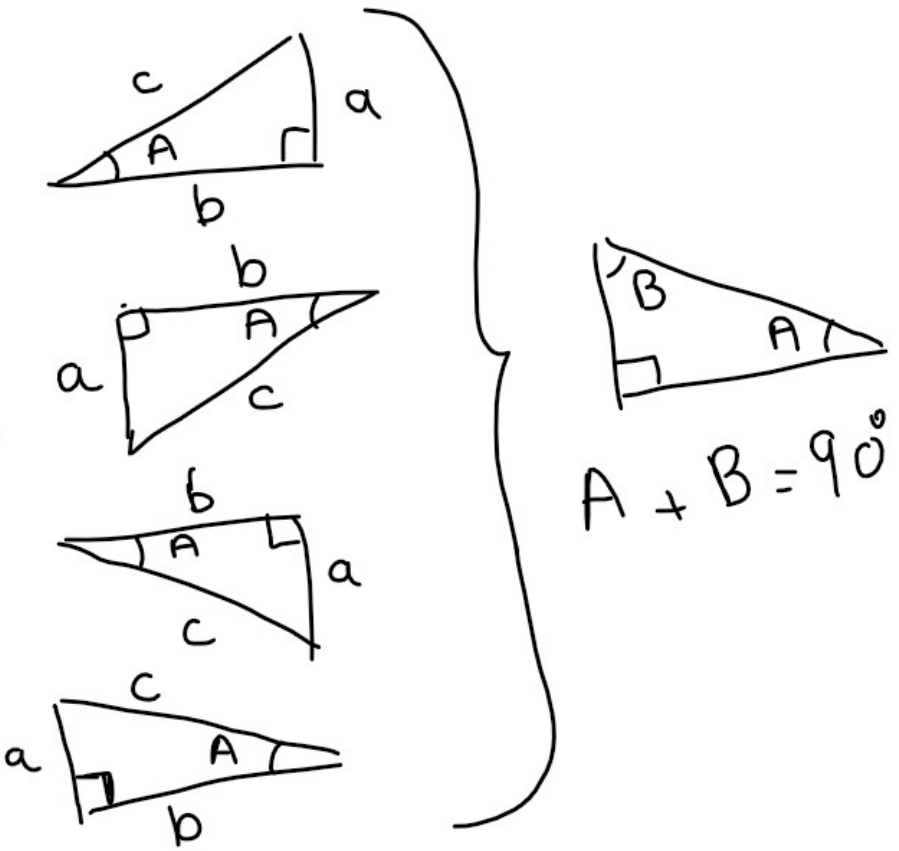
(1) $a^2 + b^2 = c^2$

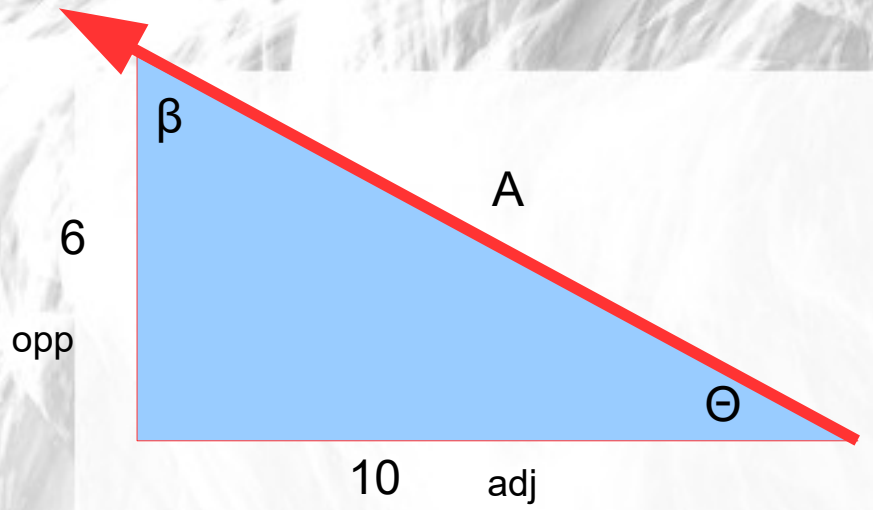
(2) $A = \tan^{-1}\left(\frac{a}{b}\right)$

(3) $\frac{a}{b} = \frac{\tan(A)}{1}$ } slope

(4) $\frac{b}{c} = \frac{\cos(A)}{1}$

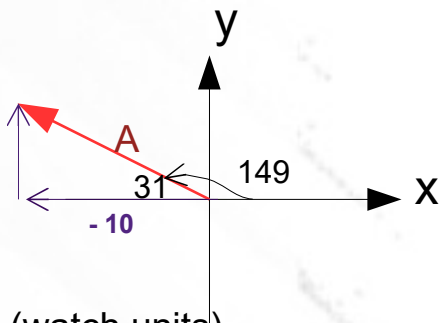
(5) $\frac{a}{c} = \frac{\sin(A)}{1}$





Questions:
- draw the vector in a x-y coordinate system and Attach the tail of the vector to the origin 0. Show the components Ax and Ay.
- Find the coordinates of AB (cartesian)
- Find the angle theta Θ
- Find the angle with the positive x-axis (use polar graph)
- Find the magnitude (Pythagorean)
- Find the standard notation

Solution:
- see @ right for 1st question
- AB(-10, 6) m
- theta = $\tan^{-1}(6/10) = 31$
- angle in polar graph = 180-31= 149
- magnitude = $\sqrt{(6^2 + 10^2)} = 12$ m
- AB = 12 m @ 149 degrees



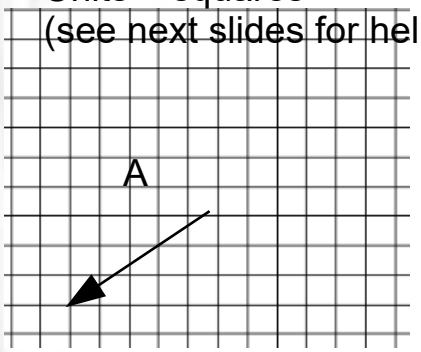
2) A vector B displacement has the components X=100 m Y = -50 m Same questions as example (watch units)

3) what about a vector velocity (plane landing) Vx=115m/s and Vy=- 200m/s. Same questions as example (watch units)

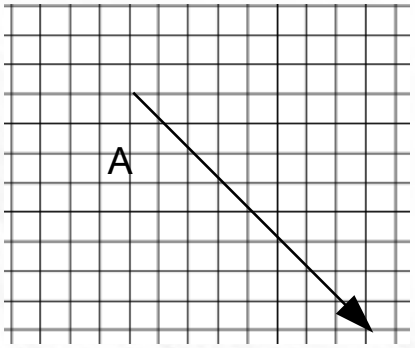
4) vector V (-100m/s, -100m/s) . Same question as example (watch units)

5) Vector displacement C (-50 cm, 20 cm). Same questions as example. Watch units.

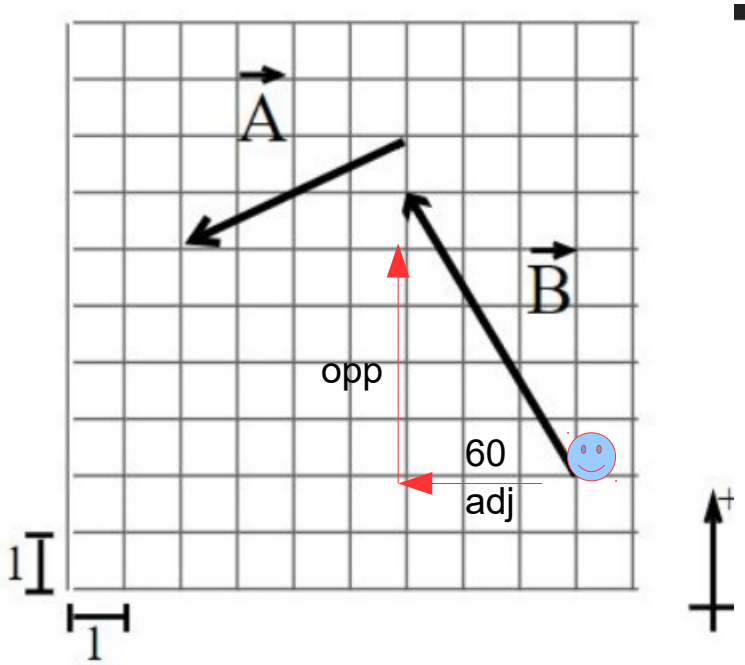
6) same questions
Units = squares
(see next slides for help)

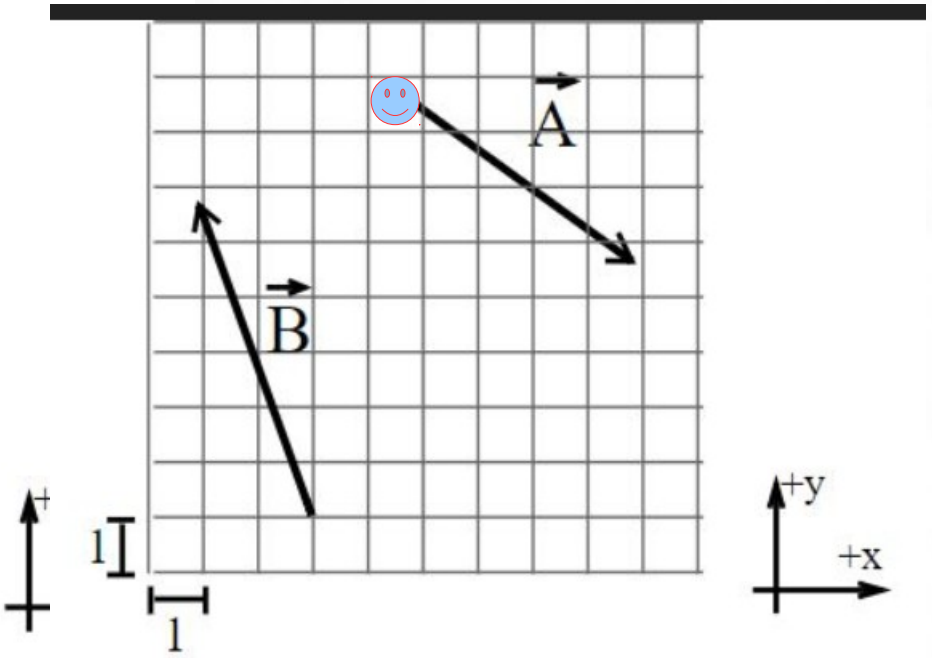


7) same



Find the components of each vector, the magnitude and the direction





Example:
B (-3,5) squares
Angle with negative x-axis = $\tan^{-1}(5/3)$ =60
Angle in polar graph = 120
Magnitude = 6 squares
B= 6 squares @ 120